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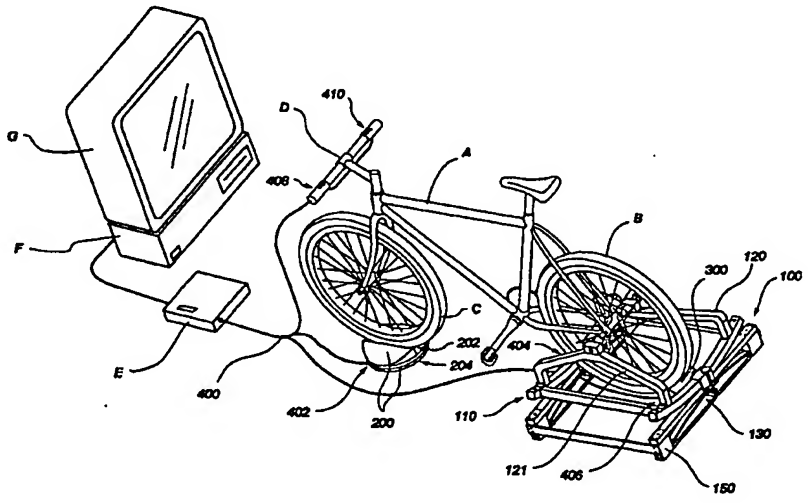

(57) Abstract

This invention is a stationary and indoor exercise apparatus that supports a traditional bicycle (A), and is associated with electronic signaling devices providing a means to deliver electronic signals to controlling device (E), that then forwards the electronic signals on to either an electronic gaming device (G), a personal computer, or a virtually reality system. In this manner, the operator of the bicycle is able to interact with video game or virtual reality interactive software while in the process of exercising. The invention's front and rear suspension systems (204, 404) support the operator and the bicycle and give a full range of motion simulation experience by allowing the bicycle and operator to experience up and down motion that mimics that ride of the open road, along with a forward and back motion that gives the operator the experience of moving forward as the bicycle is pedaled.

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STATIONARY EXERCISE APPARATUS ADAPTABLE FOR USE WITH VIDEO GAMES AND INCLUDING SPRINGED TILTING FEATURES

Field: The present invention is in the general areas of exercise machines and amusement devices. Specifically, the present invention relates to both what are known as bicycle trainers and bicycle simulators, both stationary and free-standing. More specifically, the present invention concerns bicycle trainers and bicycle simulators that have control of, and feedback from, computers, electronic video games, and/or virtual reality systems. As an amusement device only, a motorcycle-like embodiment of the invention would provide similar electronic feedback. All of these embodiments would benefit from the springed tilting features of the invention.

Prior Art: Conventional bicycle-based exercise apparatus in the prior art fall into two main categories: 1) stationary exercise bicycles and 2), trainers that work with an existing bicycle. Stationary exercise bicycles are generally not bicycles at all but retain some bicycle-like elements such as handle bars, a seat and an axially opposed pedaling system. These elements are fitted to a frame which remains stationary upon a surface or floor. The axially opposed pedaling system is connected to an impedance device that provides a resistive force that produces an exercise or training effect when the user pedals the bicycle. Some of these machines provide either a manual or an automated variable impedance device which changes the force required to crank the pedals, thereby providing an improved exercise or training effect for the user.

The major fault of the stationary bicycle is its immovable frame. The immovable frame of a stationary exercise bicycle provides an unnaturally rigid and uncomfortable exercise or training environment. Also, an immovable frame implementation limits the exercise value to the user because it easily becomes boring, thereby discouraging the user's motivation resulting in less frequent and prolonged use.

Furthermore, the stationary exercise bicycle does not create the sensation of riding a bicycle outdoors. The bicycle and operator cannot move as one in a fluid motion. A stationary bicycle

cannot turn and tilt as the operator turns and tilts. There is none of the normal side to side movement and adjustment of the bicycle during the operator's pedaling motions. In addition, no cushioning up and down movement is felt because there is no shock absorption normally felt due to inflated tires or a suspension system. None of the usual enjoyable qualities are felt with the rigid frame implementation of stationary bicycles. As a result, this form of indoor exercise is an uncomfortable and inadequate imitation of riding outdoors.

Additionally, a frame that does not move diminishes the training effect of the stationary bicycle user. The muscles tend to only be worked narrowly at one confining angle which lessens the potential for balanced muscular group development and increases the chance of injury. There is little if any balancing of the exercise bicycle involved so neuromuscular control and coordination is not fostered. Additionally, in comparison to real bicycles, the seats and pedals of most stationary bikes are of a different variety and are situated in a different relative position, producing a dissimilar sensation that does not habituate the user to the riding of mountain and road bicycles and is therefore not a good training method for those activities. Most importantly, the stationary bike is infamous in health and athletic circles for being a boring exercise. The less stimulating and motivating an exercise, the less likely it will be performed.

The second category of bicycle trainers includes trainers that work with an existing bicycle. These can be divided into the two sub-categories of 1) "rollers" and 2), resistance trainers. Generally, roller trainers are based on a stationary horizontal frame that resides on a flat surface or floor. The frame holds a horizontal array of three identically cylindrical and freely rotating rollers having rotational axes that are parallel to each other and the surface or floor. A bicycle is then mounted in an upright fashion upon the trainer with two of the rollers supporting the rear wheel and the remaining roller supporting the front wheel. The operator then balances upon the bicycle and pedals the bicycle rotating the bicycle's rear wheel. The rear wheel in turn rotates the two rollers on the roller trainer with which it contacts. A

drive system that makes use of an endless belt or cord transfers motion from at least one of the rear rollers to the front roller so that the bicycle's front wheel can turn in synchrony with the bicycle's rear wheel.

One problem with roller trainers is that they are only designed to train the operator to pedal with constant angular force. They are not designed to provide resistance training. Roller trainers also suffer from being very hard to balance even for the highly skilled. If the operator tilts slightly to either side, the bicycle will fall and injury to the operator can result. Thus, roller trainers essentially have an immovable frame during use creating a limiting and rigid training environment.

On the other hand, a resistance trainer incorporates a stationary frame which rigidly connects with the rear hub/axle of an upright bicycle, thereby suspending the rear wheel of the bicycle above the ground while the front wheel rests on the ground. Connected to the stationary frame is an impedance device which sits in contact with the bicycle tire and provides a resistance force. The operator then sits upon the bicycle and pedals against the resistance force.

Trainers that work with an existing bicycle are an improvement over stationary bicycles in that they are much lighter and can be easily transported. Also, they can take up less space and are easier to store. Moreover, they are less expensive because a large portion of the needed equipment is provided by the existing bicycle and they usually require a smaller impedance mechanism than those employed by stationary exercise bicycles because the rear wheel assembly acts as the flywheel that most stationary exercise bicycles employ.

However, with respect to athletic training, trainers that work with an existing bicycle are only a minor improvement over stationary exercise bicycles. While trainers that work with an existing bicycle are better at habituating the operator to the riding of road bicycles and mountain bikes, they remain problematical in this area and they still have the other aforementioned diminished training effects associated with an immovable frame.

To solve the diminished training effects associated with the immovable frames of conventional bicycle trainers such as stationary bicycles and trainers that work with an existing bicycle, inventors have produced what can be termed "bicycle simulators."

United States Patent No. 4,082,265 by Berkes discloses a bicycle support system for maintaining a bicycle in a generally upright position on a roller trainer while permitting tilting of the bicycle as an attempt to simulate normal riding conditions. The support system has two elongated legs that fit one on each side of the bicycle. The legs attach the bicycle's frame at the seat post and at their other end to the roller trainer.

While the device disclosed by the '265 patent does have the capability of tilting, this tilting is limited by the device's spatial configuration and is less than that which can be achieved in realistic conditions. Also, the simulator is not designed to have any other movement besides its limited tilting and so therefore cannot fully simulate the vertical and pitching movements of real bicycle riding. Lastly, because the device does not have an impedance capability it cannot train the operator effectively.

US Patent No. 4,580,983 discloses another roller trainer that has a support system intended to allow limited deviations from vertical. This attempt at a simulator has a roller trainer that has only two rollers. The support system contains a bracket which attaches to both sides of the existing bicycles rear wheel hub. This symmetrical bracket is free only to rotate about its axis of symmetry and slide horizontally in a slideway.

The device disclosed in the '983 patent is ill-conceived because if its support system is stiff then it renders itself non-functional and if its support system is flexible it will not hold the bicycle upon the roller trainer. Even if these problems could be overcome, the device suffers from the same faults as the device disclosed in the '265 patent. Again there is only a small amount of tilting and no vertical or pitching movements such that realistic bicycle riding cannot be simulated. Similarly and lastly, because the device does not have an impedance capability it cannot train the operator effectively.

US Patent No. 4,958,832 discloses a bicycle simulator that includes a bicycle that rides upon a textured treadmill. In order to keep the bicycle upon the treadmill, the frame of the bicycle is connected to the frame of the treadmill by a mechanical device. This mechanical device allows the bicycle the freedom to move upon the treadmill while not allowing the bicycle enough freedom to move off of the treadmill.

One problem with the bicycle simulator disclosed by the '832 patent is that its securing structure only allows a limited tilting of the bicycle frame. Furthermore, this limited tilting must occur for only a short duration of time. Upon critical examination of the specification it is clear that a second problem of the device is that the bicycle can be driven off of the treadmill under certain conditions, thereby endangering the operator. A third problem is that the vertical movement of the bicycle frame is severely limited because the vertical movement is dependent upon the vertical texture of the treadmill. The vertical texture of the treadmill cannot be so great as to render the treadmill unworkable. Thus, there can be only small vertical movements of the bicycle frame. Lastly, a fourth problem with the simulator is that it does not have an impedance capability and because of this the development of the strength and endurance of the operator is lessened.

US Patent No. 5,240,217 discloses an arcade-game-style bicycle simulator. This device serves as an imitation bicycle that has somewhat the appearance of a real bicycle except that the pedals do not drive the bicycle's wheel, but instead drive a shaft of a complex mechanism located in the simulator's base. Also, the imitation bicycle's frame is not supported by its wheels but is instead supported by a linking member that is controlled by the complex mechanism. This simulator has very limited or no value as a training or exercise device, the primary design approach and purpose of this invention is to serve as an arcade amusement device, it is not intended for the home game player or for anyone interested in being entertained while they are exercising.

This device and its computer controls then serve only as an input device for custom arcade software. It does not interact with the game in the same fashion as the as an input device/game adapter

would for the computer video games commonly found in the home environment such as the Super Nintendo Entertainment System, Sega and Personal Computers that are widely used and well known. This device has very limited appeal and is designed for the arcade arena. It also lacks the realism of a springed bias tilt function on the bicycle adapter. The operator must throw the device from a right tilt to center to left and back again. The resulting implementation does not leave the operator with the impression that a bicycle simulator with a bias springed resistance would provide.

US Patent No. 4,512,567 discloses an exercise bicycle that has a movable handlebar. The handlebar movement and the pedaling movement cause a microcomputer to operate a video game. While this device does have some value as an exercise piece of equipment the implementation falls short as a device that will create a sensation for the operator that imitates a natural bicycle ride as would exist in a true bicycle simulator. Again, the natural forces felt as the result of an bicycle operator going into a turn are not duplicated by the technology. Indeed, the sense of realism is not achieved at all since the operator cannot even tilt the bicycle during the course of a normal turn, only the handle bars can turn to a limited degree. The device is essentially the same as other stationary exercise bicycle implementations as it remains rigidly attached to the floor during the course of the ride. Adding the electronic attachments so that the operator can interact with a video game creates a situation where a video game can be played while exercising, but the motivation level experienced by the operator is limited because the bicycle does not simulate the natural environment, the operator would only experience a limited level of involvement while playing the game.

BRIEF SUMMARY AND OBJECTS OF THE INVENTION

The stationary exercising apparatus that is the present invention attaches to either a free-standing bicycle or is part of a stationary exercise bicycle that simulates an environment where the operator experiences three-dimensional motion and pedaling resistance similar to that of riding a real bicycle outdoors.

The operator can initiate a series of bicycle riding movements including simple left and right turning, side to side biased

springed tilting, forward and back motion, up and down springing actions as well as complex combinations of these movements. Ideally, this occurs while pedaling against a rolling impedance device that provides resistive force against the operator's pedaling actions. This rolling impedance device interactively simulates the varying resistance levels the operator would experience when encountering such obstacles as pedaling up or down hills or going through water.

The apparatus, with or without the varied impedance mechanism, can act as an interactive electronic controller to provide input to and receive feedback from a video game system or personal computer system with a screen or monitor mounted in front of the operator to provide a near virtual reality exercise experience that is more entertaining and engaging than current exercise bicycle implementations thereby providing a much higher level of exercise motivation.

Without the varied impedance mechanism the apparatus can function well as a motorcycle-like adapter for video games where the operator is still free to move the machine into turning and tilting maneuvers that provide feedback to the video game or system. Although the exercise value of this implementation is diminished by the loss of the pedaling exercise or training effect, the apparatus still does provide some exercise or training value in the form of the effort required to throw the bike into the tilting or turning movements. This embodiment would provide a greatly enhanced entertainment value requiring the player to use one's entire body in order to play the game and adds to the realism of many race type video games currently available.

Additionally, a handlegrip-mounted button assembly can be used in combination with the exercise apparatus to provide switch input compatibility with video and computer games, and/or virtual reality systems.

Generally, the apparatus of the invention comprises at least five main parts. These five main parts are the exercise bicycle, the rear wheel support frame, the impedance mechanism, the front wheel support base, and the interactive electronic componentry.

The exercise bicycle is a generally, but not solely, a driving system that can provide the following: a chassis including a seat upon which the operator can sit, a rear wheel that rotates relative to said chassis, an axially opposed pedaling mechanism that rotates the wheel, and handlebars that the operator can grasp. The preferred embodiments of the exercise bicycle include either an existing bicycle that can be attached to the support frame or an implementation of the upper part of a stationary bicycle exercise trainer that can likewise be mounted on the support frame platform to provide the same effect. Also mentioned earlier is the possibility of an embodiment where a bicycle is employed that does not require a pedaling force from the operator but instead provides an entertainment experience similar to riding a motorcycle.

The support frame can contain support arms, a springed mechanism and a frame base. The support frame is designed such that the rear wheel of the exercise bicycle chassis is held, suspended and free to rotate in space while concurrently the frame is free to move in space.

The impedance mechanism is stably connected to the support frame and applies a force of resistance to the rotation of the wheel.

The support base includes a channel for receiving the front wheel that is mounted on a set of roller bearings that provide a pivoting platform. This platform remains fixed, the support base being in contact with a firm surface while it allows the front tire of the exercise bicycle to turn freely, as controlled by the operator, to the left or to the right.

The interactive electronic componentry can be composed of generally available devices such as wires or wireless transmission devices, mercury sensors, button-controlled switches, a microprocessor, software, video game/personal computer/virtual reality interface and monitor display.

Specifically, in the preferred embodiment of the present invention, the exercise bicycle includes a free-standing exercise bicycle chassis or a stationary exercise bicycle which also supplies a pedaling system and rotating wheels. Another embodiment would be to employ a motorcycle-like frame attachment that provide no

driving system, but allows the operator to sit upon the device as a game adapter.

The invention can contain support arms and rocker arms as part of the support frame, torsion springed bars and tension springed bars along with an adjustment device for the springed mechanism, and base blocks with side support rails along with front and back support rails to comprise the frame base.

The impedance mechanism is a variable electromagnetic resistor that is controlled by input from the interactive electronic game or software. The impedance mechanism applies its force to the exercise bicycle wheel. Another preferred embodiment would be to require no pedaling at all, as in the case of riding a motorcycle, to be able to interact with the many games and software in the prior art which imitate riding a motorcycle.

The interactive electronic componentry contains passive speed and position sensors located on the front wheel support base to determine front wheel turning status and position, the rear wheel rocker arm to determine apparatus tilt status and position, and the impedance mechanism to provide motion sensing. Switches requiring the operator to actively press a button located on the handlebar of the bicycle provide full function video game compatibility (weaponry, options etc.) to a variety of prior and future art gaming systems including but not limited to Atari, Nintendo, Super Nintendo, Sega, Sony Playstation, Personal Computer CD ROM systems, and also including more recent virtual reality systems.

The software media includes but is not limited to game cartridges, CD-ROMs, and software code specific to the integrated microprocessor. The video game/personal computer interface includes but is not limited to joy stick ports, parallel ports and other common and proprietary video game interfaces and adapters.

The monitor includes but is not limited to a either a computer display/monitor, a television set, or a virtual reality set of display goggles.

The operator would use the invention in the following manner. First, in the case of mounting a free-standing exercise bicycle onto the invention, the operator positions the rear wheel of the exercise bicycle above the fastening device located at the top of the support

frame support arms. The operator then secures the rear axle/hubs by placing the axle/hubs into the fastening device and then tightening the threaded shaft, advancing the threaded shaft to engage and maintain the rear wheel axle in a fixed position. When fastened in this manner the rear wheel of the bicycle would then be held suspended in space, but still connected to the support frame of the invention and also with the rear tire pressed firmly against the roller of the impedance mechanism. The operator would then place the front tire of the bicycle into the tapered channel of the support base, providing a support for the front tire that allows for left and right front wheel turning movements as the operator desires. At this point the operator would connect the interactive electronic componentry to a video game, personal computer, or virtual reality system of choice and set the options switches and settings to correspond to the game or software that the operator has chosen to employ. Before climbing on the invention the operator will adjust the springed mechanism to his/her specific weight, suspension preference and also adjust the maximal tilt setting. The operator would then mount the exercise apparatus and begin pedaling the exercise bicycle. While thus using the invention the impedance device would provide a resistance force against the pedals. The resistance force can be altered in two ways; first the operator can shift the exercise bicycle existing gears and second, the interactive componentry can electronically vary the resistance force. As the operator pedals the bicycle the support frame moves both vertically and forward and back due to the flexing of the tension springs. This mimics the undulations in the road and the natural shock absorption of a bicycles tire. In the case of simulation of a turn the operator initiates the turn by a slight movement of the handle bars which is followed by a shifting of the operators weight that in turn initiates a tilting or tilting of the bicycle. As this happens, the support arms tilt on their rocker arms from the central pivot point flexing the torsion bars (attached to the rocker arms at the pivot points) into an 'S' shape, providing an increasing resistance as the tilt deepens until the rocker arms reach the tilt angle stops. As the operator pulls out of the tilting turn the torsion springs straighten and assist the operator

as the operator shifts weight to bring the bicycle back to vertical equilibrium. Throughout the entire range of possible motion the support frame and the support base provides a stable platform.

Accordingly, the present invention overcomes the faults of the prior art by providing a bicycle exercise or training simulator that is capable of creating a more realistic and stimulating exercise or training environment.

Specifically, one of the objects of the present invention are to provide realistic three-dimensional movement including 1) a maximal and adjustable springed left and right tilt and turn capability with an increasing springed resistance as the degree of tilt increases, 2) an up and down movement capability and 3) a forward and back movement capability.

Another object to enhance the realistic motion of the riding experience is to provide for turning and/or tilting of the free-standing exercise bicycle, stationary exercise bicycle or motorcycle-like frame.

A further object is to provide a spring adjustment mechanism in order to accommodate operators of different weights and preferences.

An additional object is to provide an impedance mechanism that moves with the frame of the simulator. This impedance mechanism can provide variable levels of resistance force which can also be computer input controlled.

Still another object of this invention is to provide an easy-mounting mechanism upon an existing bicycle's hub/axle that even children can actuate.

Another important object of this invention is to provide a device that delivers an enhanced exercise or training environment with a more complete muscle group workout with greater strength, better endurance, and increased balance and coordination as the result.

Another important object is the practicality of the invention's design. This includes making the invention simple and easy to manufacture, relatively inexpensive, safe, aesthetic and easy to use, store and move.

Yet another object of this invention is to provide a device that, although usable as a stand alone training device, is capable of being employed as an interactive video game input device. This input device will provide system capability with multiple current and future video games, personal computer and virtual reality platforms. Within each of the supported gaming platforms, switched button programmability will allow support of games with varying button functionality. In addition, the device will be capable of providing complex input combining input from multiple sources on the trainer.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the manner in which the above recited and other advantages and objects of the invention are obtained can be appreciated, a more particular description of the invention briefly described above will be rendered by reference to a specific embodiment thereof which is illustrated in the appended drawing. Understanding that this drawing depicts only a typical embodiment of the invention and is not therefore to be considered limiting of its scope, the invention will be described and explained with additional specificity and detail through the use of the accompanied drawing in which:

Figure 1 is an isometric perspective view of the current invention shown with a free-standing exercise bicycle placed upon the invention in front of a computer or video game monitor that provides visual and audio feedback to the operator of the bicycle as the operator progresses.

Figure 2 is an isometric perspective view of the support frame that supports and maintains the rear wheel of an exercise bicycle when it is placed upon the invention.

Figure 3 is an isometric perspective view of the support base that supports the front wheel of a bicycle when it is placed upon the invention.

Figure 4 is a rear elevational view of the support frame including the left and right support armatures, the rear springed mechanism, and the frame base components.

Figure 5 is a rear elevational view similar to Figure 4 showing the resulting configuration of the support frame that would occur when the invention is in a tilting or turning configuration.

Figure 6 is a rear elevational view of another preferred embodiment as a non-exercise, motorcycle-like game adapter.

Figure 7 is a side elevational view of the invention's front wheel support base and rear wheel support frame shown supporting the front and rear wheels of an exercise bicycle placed upon the invention.

Figure 8 is a simplified perspective view of the variable impedance mechanism employed as one of the preferred impedance mechanisms providing resistive force for this invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Figure 1 is an isometric perspective view of the preferred embodiment of the present invention. An existing free-standing exercise bicycle A has been placed in an upright fashion upon the present invention. The rear wheel B of the exercise bicycle A is attached to the support frame 100 while the front wheel C is inserted into the channel 202 of the support base 200. The rear wheel of the exercise bicycle A is temporarily fastened to the support frame 100 and contains a support armature, a springed mechanism 130 and a frame base 150. The front wheel C pivoting platform 200 comprises a tapered channel 202 to receive the front tire C that rotates relative to a stationary base 204. The rear tire B contacts the rolling impedance mechanism 300 contained within the support frame 100. An interactive electrical componentry system 400 containing passive movement sensors 402, 404, and 406, and active control switches 408 and 410 is attached to the rear wheel support frame 100, the front wheel C support base 200 and the bicycle handlebars D. The sensing switches are commonly available mercury position sensing switches that will provide electronic signal feedback to the gaming device when the operator turns or tilts the device. The sensor located at the rolling impedance mechanism 300 is also a commonly available motion sensing electronic switch that will provide input as to when the operator is pedaling forward. The switches located in the handlebars D are also commonly available on/off button switches that the operator can operate with

finger control allowing for feedback to the gaming device F for weaponry or options control. Through a controller/interface system E they provide input and receive feedback from a computerized interactive gaming device F. In front of the exercise bicycle A is an example of a visual feedback device G such as a television monitor or computer display. Another preferred embodiment employs a virtual reality system display headset (not shown).

Figure 2 is an isometric close-up perspective view of the rear wheel support frame 100 along with the variable impedance mechanism 300 of the preferred embodiment. The rear wheel support frame 100 incorporates a support armature, a springed mechanism 130 and a frame base 150. The axle locking fastening mechanism 111 is located on and is stable to the tops of the support arm 120 and 121. The axle locking fastening mechanisms 111 holds the rear wheel axle or hub of the bicycle in place relative to the support frame 100.

The axle locking fastening mechanisms 111 includes the axle guide 112, the axle locking bolt threaded shaft 113, the adjustment knob 114, the right and left locking bolt assemblies 115 and the locking bolt cups 116 and 117. The locking bolt cups 116 and 117 are hollow cylindrical receptacles which hold the bicycle axle/hub. The axle locking bolts 113 are shafts which are threaded through the locking bolt assemblies 115. The locking bolts 113 attach to the locking bolt cups 116 and 117 on one of its ends and at its other end it has an adjustment cranks 114. When turned, the adjustment cranks 114 moves their attached locking bolt cup 117, thereby causing the locking bolt cups 116 and 117 and 116 to move closer together. This movement causes the locking bolt cups 116 and 117 to firmly engage and maintain the bicycle rear wheel axle/hub, holding it securely. The locking bolt cups 116 and 117 are freely pivoting.

The right support member 120 and the left support member 121 are both triangular shaped members which attach at each of their ends to the front 122 and rear 123 rocker arms. These attachments to the rocker arms 122 and 123 allow the support members 120 and 121 to move towards each other and then downwards into the base when folded for storage.

The front rocker arm 122 and the rear rocker arm 123 are attached to each other by the left rocker arm connector 124 and the right rocker arm connector 125. The front rocker arm and the rear rocker arm are attached at the middle of their arcs to the springed mechanism 130 via the spring adjustment assemblies 131 and 132. These spring adjustment assemblies 131 and 132 attach the rocker bars 122 and 123, the torsion bars 133 and 134, and the tension springs 135 and 136 together at their respective mid-points.

The springed mechanism 130 incorporates a front torsion bar 133, a rear torsion bar 134, a front tension spring 135, a rear tension spring 136, a front spring adjustment assembly 131 and a rear spring adjustment assembly 132. The torsion bars 133 and 134 are straight elastic members which provide a three dimensional spring force against the support armature and rocker arms 122 and 123, and are attached at their ends to the four base blocks 152. The tension springs 135 and 136 are pre-arched leaf springs which provide a vertical force to the support armature and rocker arms 122 and 123 and float freely at their ends in cavities within the four base blocks 152. The rear spring adjustment assembly 132 is comprised of a rear torsion bracket 137 and a threaded rear adjustment bolt 138. The rear torsion bracket 137 clamps together the rear rocker arm 123, the rear torsion spring 134, and the rear tension spring 136. The rear adjustment bolt 138 is threaded through the rear torsion bracket 137 and varies the relative position between the rear torsion spring 134 and the rear tension spring 136, thereby adjusting the spring force of the rear torsion spring 134 and the rear tension spring 136. The rear tension spring 136 sits underneath the rear torsion bracket 137 of the rear spring adjustment assembly 132. The front spring adjustment assembly 131 is analogous in structure and function to the rear spring adjustment assembly 132.

Figure 3 is an isometric perspective view of the support base 200 that supports the front wheel C of an exercise bicycle A when it is placed upon the invention. The support base 200 employs a channeled plastic upper piece that is tapered so that the front tire C of a bicycle will easily fit into the channel 202. An free-standing exercise bicycle A is placed upon the invention with the

front wheel C of the bicycle being placed into the tapered channel 202 located on the top piece of the support base 200. The top piece is connected to a freely-rotating circular platform that rides on a ball-bearing disk located within a stationary disk 204 and provides the ability to easily turn the front wheel C and exercise bicycle handlebars D from side to side and passively provide signal feedback to the electronic gaming system F as to the direction and degree of the turn. This electronic signal is provided by a set of dual mercury sensing switches 402 that will provide signal feedback to the electronic system 400 whenever the operator turns the bicycle handlebars D to the left or to the right and trips the switches. The support base 200 raises the front wheel C of the bicycle A some 2-3" off the level ground and equalizes the amount that the rear wheel B is raised off the ground when placed upon the rear wheel support frame 100.

Figure 4 is a rear elevational view of the rear wheel support frame 100 of the preferred embodiment. This figure demonstrates a different viewpoint of the present invention and includes the support members 120 and 121 and rear rocker arm 123, the springed mechanism 130, and the frame base 150. The variable impedance mechanism 300 is also visible in this perspective.

The support members 120 and 121 and rear rocker arm 123 as shown also show the axle locking fastening mechanism 111 located at the top of the support armature.

The axle locking fastening mechanisms 111 are secured at the uppermost angle of the support members 120 and 121, and are fixed securely to these members. When the rear axle of the rear wheel B of an exercise bicycle A is placed into the locking bolt cups 116 and 117 of the axle locking fastening mechanisms 111 and then held in a fixed position upon the present invention as the adjustment knobs 114 on the axle locking bolts 113 are turned. This creates a tightened hold on the rear axle thereby engaging and securing the rear axle and thus the exercise bicycle A to the present invention.

Supporting this axle locking fastening mechanism 111 are the support members 120 and 121 and the rocker arms 122 and 123. The front rocker arm 122 is not visible in this figure. This figure shows the rear section of both the right and left support members

120 and 121. The support members 120 and 121 are shown unfolded into an upright position as they would be when supporting the rear wheel B of an exercise bicycle A locked securely in the axle locking fastening mechanisms 111. The rear rocker bar 123 has a right tilt angle stop 126 and a left tilt angle stop 127 which are located near its ends. The tilt angle stops 126 and 127 act as a détente to prevent the bicycle from tilting beyond a set tilt angle from vertical. The support members 120 and 121 are prevented from opening beyond their desired position as they pivot on the pivot pins secured within the rocker arms 122 and 123.

Since this perspective is of the rear view only the attachment of the rear sections of the left and right support arm 120 and 121 to the rear rocker arm 123 are visible. In similar fashion, the front sections of the left and right support members 120 and 121 are connected to the front rocker arm 122. The rear rocker arm 123 shown is a curved bar that allows the attached support members 120 and 121 holding the rear wheel B of the exercise bicycle A to rock from stationary to the right or left side with a maximal degree of tilt being determined by the rear rocker arm 123 tilt stops 126 and 127 located at the distill ends of the rear rocker arm 123.

Figure 5 is a rear elevational view of the rear wheel support frame 100 similar to the perspective shown in Figure 4. The view point of Figure 5 however shows the configuration of the present invention when in a right hand tilt position. This is the configuration that would occur when the rear wheel B of a free-standing exercise bicycle A has been locked securely in the axle locking fastening mechanism 111, a operator has mounted the exercise bicycle A attached to the invention and is in the process of going through a hard right hand tilt maneuver.

In either of these maneuvers as the operator initiates the tilt the support members 120 and 121 and rocker arms 122 and 123 that hold the rear wheel B of the exercise bicycle A would start to angle from a normal upright stationary position to an angled degree of tilt. The tilt of the bicycle would cause the rocker arms 122 and 123 to roll to either the left or right side of the rocker arm curve. In Figure 5 the support members 120 and 121 and rear rocker arm 123 are shown in configuration of an angled tilt to the right.

During the course of this maneuver the dual electronic mercury sensing switches would sense the tilt as the operator moved the invention into either a right side tilt or a left side tilt and then send an appropriate signal to the controller. The electronic signal would be passed to the gaming device F and the gaming software would interact so as to turn the character in the game in accordance with the operator's tilt of the bicycle A.

Figure 6 is a rear elevational view of another preferred embodiment of the present invention previously mentioned where the device does not serve primarily as an exercise apparatus, but instead serves as a motorcycle M video game input device that the operator would sit upon with the operator's feet resting upon the pegs P with hands grasping firmly the handlebars N. The operator would throw the motorcycle M into right and left tilts and turns as required by the course with weapons controls located on the handlebars N, but no peddling action would be required to move the operator forward through the course as the operator feet would sit upon the motorcycle pegs P. This embodiment would act as a motorcycle simulator for entertainment purposes and mimic to a considerable extent the function and natural feel of a motorcycle on a course. This embodiment also shows an additional possibility for the springed system employing a coiled spring tension array 600 in place of the leafed tension spring used in the other figures. The rocker bar 500 implementation and the torsion bar embodiment remains consistent with the other figures providing a biased spring tilt that mimics the natural forces and feelings of centrifugal forces felt when the operator initiates a tilt and turn maneuver.

Figure 7 is a side elevational view that shows the front and rear wheels C and B of a free-standing exercise bicycle A mounted upon the present invention. The rear wheel B of the bicycle is fastened securely to the rear wheel support frame 100 of the present invention and is held firmly in place by the locking axle fastening mechanism located at the topmost section of the support members 120 and 121 of the support frame 100. The rear wheel B of the bicycle A is thus suspended above the ground, engaged and maintained to the support frame 100 by the axle locking fastening mechanisms 111. When the rear wheel B axle/hub of the exercise bicycle A is thus

secured the rear wheel B is pressed against the roller of the impedance mechanism 300. This rolling impedance mechanism 300 is held in place by a springed action that provides pressure firmly against the bicycle's rear wheel B. As the operator pedals the exercise bicycle A and rotates the rear wheel B, the rear wheel B encounters a resistive force from the variable impedance mechanism 300 providing training value to the operator. The variable impedance mechanism 300 is attached to the rear rocker arm 123 and is thereby held in a constant position perpendicular to the rear wheel B of the attached exercise bicycle A. A motion sensitive electronic sensor 406 will provide a signal to the controller F whenever the rear wheel B of the bicycle A turns the variable impedance mechanism 300 roller. A similar signal will be generated when the device brakes and the motion of the rear wheel B and the variable impedance mechanism 300 roller stop. This will allow the gaming software to interact to the riding motion of the operator and cause the game character to move forward or stop accordingly, in cadence with the operator's peddling actions.

The front tire C rests in a channel 202 of a disk shaped support base 200 and is held in place by an attachment strap.

Figure 8 is a simplified perspective view of the internal electromagnetic workings of the variable impedance mechanism 300. The impedance mechanism 300 operates on the principle of magnetic attraction. Permanent magnets 301 are mounted on a circular rotating disk. This rotating disk shall be referred to as the rotor 303.

Mounted next to the rotor 303 is a disk of similar dimensions, containing an equal number of electromagnets 302 corresponding to the permanent magnets 301 of the rotor 303. This disk is referred to as the strator 304. The strator 304 is fixed and does not rotate or move. The strator 304 is located in close proximity to the rotor 303 and provides for a small air gap between the rotor 303 and the strator 304.

The permanent magnets 301 are mounted on the rotor 303 with the South pole facing out. The electromagnets 302 of the strator 304 are energized with a proportional voltage to create a North pole on the strator 304's outside face. As dissimilar poles attract, an

attraction field is created between the strator 304 and the rotor 303. The rotor 303 is attached to a shaft 305 that is friction coupled to the rear wheel B of the exercise bicycle A and is held firmly against the rear wheel B by a spring. When the operator of the bicycle A attempts to pedal the bicycle A and rotate the rear wheel B, the rotational movement of the rotor 303 is resisted by this magnetic field.

The strength of the field is controlled by a digital value presented to the impedance mechanism controller 306 via the software. In this fashion the impedance mechanism 300's resistance levels can be constantly varied to match the requirements of the software, providing training and entertainment value to the operator.

The physical size of the impedance mechanism 300 is approximately four inches in diameter and approximately two to three inches thick.

Another preferred embodiment of the impedance mechanism 300 is to employ a standard motor through which a direct current has been run. As the voltage is increased the amount of resistance to the rear wheel will also increase providing the same training value as the electromagnetic resistance. This device may also be controlled by the use of a digital value that can be presented to the controller via the software. In similar fashion the mechanisms can be constantly varied to match the requirements of the software.

The invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

CLAIMS

1. A stationary exercise apparatus for simulating actual movement experienced during free bicycle riding on an actual road surface when used together with an exercise bicycle and for connection to an existing video game and related mechanism, the apparatus including:

a support frame, the frame including a plurality of contact points for contacting a firm surface thereby maintaining the bicycle in a relatively stationary position; and

tilting means connected to the frame for allowing the bicycle to tilt about an axis longitudinal to the bicycle responsive to a shift in weight by an operator, the tilting means including

at least one rocker arm, each rocker arm being disposed so as to rock about the axis longitudinal to the bicycle, and

at least one spring corresponding to each rocker arm for providing resistance when the weight shift occurs.

2. A stationary exercise apparatus for simulating actual movement according to Claim 1, wherein the bicycle is a stationary exercise bicycle.

3. A stationary exercise apparatus for simulating actual movement according to Claim 2, wherein the stationary exercise bicycle is mounted on a platform, the platform in turn being mounted on the support frame such that the stationary exercise bicycle can tilt using the tilting means about the longitudinal axis.

4. A stationary exercise apparatus for simulating actual movement according to Claim 1, wherein the bicycle is free-standing, and includes

a chassis including a seat upon which the operator can sit,

a front wheel having steering capabilities and connected to the chassis,

a rear wheel connected to the chassis, and

a handlebar in communication with the front wheel for grasping by the operator and by which the steering capabilities are effected.

5. A stationary exercise apparatus for simulating actual movement according to Claim 4, further comprising a support base, the support base being in contact with a firm surface and including a channel for receiving the front wheel, the support base for aiding in the support of the bicycle.

6. A stationary exercise apparatus for simulating actual movement according to Claim 5, wherein the channel for receiving the front wheel of the bicycle tapers from a wider open end to a narrower closed end.

7. A stationary exercise apparatus for simulating actual movement according to Claim 1, wherein the tilting means includes a maximum angle from the vertical, past which the exercise bicycle will not go in order to ensure the safety of the operator.

8. A stationary exercise apparatus for simulating actual movement according to Claim 7, wherein a resistance against tilt is provided as the operator shifts weight to initiate tilt.

9. A stationary exercise apparatus for simulating actual movement according to Claim 8, wherein the resistance against tilt increases as the angle from vertical increases as the operator shifts weight to initiate tilt.

10. A stationary exercise apparatus for simulating actual movement according to Claim 1, further comprising driving means for simulating actual movement of the exercise bicycle by requiring some action by the operator.

11. A stationary exercise apparatus for simulating actual movement according to Claim 10, wherein the driving means includes axially opposed pedals which are rotated by the operator to simulate free bicycle riding.

12. A stationary exercise apparatus for simulating actual movement according to Claim 11, wherein the driving means further includes impedance means for providing a resistive force as the operator rotates the axially opposed pedals, thereby providing physical exercise to the operator.

13. A stationary exercise apparatus for simulating actual movement according to Claim 12, wherein the resistive force is selectively variable.

14. A stationary exercise apparatus for simulating actual movement according to Claim 13, wherein the resistive force is selectively variable responsive to electronic input.

15. A stationary exercise apparatus for simulating actual movement according to Claim 14, wherein the electronic input is provided by a video game.

16. A stationary exercise apparatus for simulating actual movement according to Claim 14, wherein the electronic input is provided by a virtual reality headset system.

17. A stationary exercise apparatus for simulating actual movement according to Claim 14, wherein the electronic input is provided by a computer game.

18. A stationary exercise apparatus for simulating actual movement according to Claim 13, wherein the exercise bicycle further comprises a set of gears and the resistive force is selectively variable responsive to manual changes in engagement and disengagement of the driving means to individual gears in the set of gears.

19. A stationary exercise apparatus for simulating actual movement according to Claim 4, further comprising connecting means for temporarily connecting the free-standing bicycle to the support frame such that the bicycle is maintained in relatively upright stationary position.

20. A stationary exercise apparatus for simulating actual movement according to Claim 17, wherein the connecting means connects the rear wheel of the free-standing bicycle to the support frame.

21. A stationary exercise apparatus for simulating actual movement according to Claim 17, wherein the connecting means is integral to and part of the support frame.

22. A stationary exercise apparatus for simulating actual movement according to Claim 19, wherein the connecting means comprises at least one support arm having first and second ends, each first end being rigidly attached to the rocker arm near an end thereof and each second end including fastening means for temporarily fastening that support arm to the rear wheel of the exercise bicycle.

23. A stationary exercise apparatus for simulating actual movement according to Claim 20, wherein at least two support arms

acting in combination provide support to opposing ends of the rear wheel axle, the fastening means comprising a threaded shaft having means for receiving an end of the rear wheel axle, the threaded shaft being advanced to engage and maintain the rear wheel axle in a fixed position and retracted to disengage and release the exercise bicycle from the support frame.

24. A stationary exercise apparatus for simulating actual movement according to Claim 4, further comprising impedance means for providing a resistive force as the operator operates the exercise bicycle.

25. A stationary exercise apparatus for simulating actual movement according to Claim 22, wherein the impedance means comprises an electromagnetic resistor which controls the rotation of a roller which is in contact with the rear wheel of the exercise bicycle.

26. A stationary exercise apparatus for simulating actual movement according to Claim 1, wherein the exercise bicycle is connected to an audiovisual sensory means for providing input to the operator of the exercise bicycle.

27. A stationary exercise apparatus for simulating actual movement according to Claim 24, wherein the audiovisual sensory means includes a pre-programmed video game which aids in creating for the operator a sensation that the exercise bicycle is riding freely on an actual road surface.

28. A stationary exercise apparatus for simulating actual movement according to Claim 24, wherein the audiovisual sensory means comprises

a plurality of movement sensors disposed at strategic position on the exercise bicycle and support frame;

a plurality of control switches disposed on the exercise bicycle within easy reach of the operator;

an interactive electronic processor for receiving input and rendering output information responsive to information received from the sensors and switches; and

an interface controller for making compatible the input information received from the sensors and switches and the output information rendered by the processor.

29. A stationary exercise apparatus for simulating actual movement according to Claim 26, further comprising a visual feedback device.

30. A stationary exercise apparatus for simulating actual movement according to Claim 27, wherein the visual feedback device is a display monitor.

31. A stationary exercise apparatus for simulating actual movement according to Claim 27, wherein the visual feedback device is a virtual reality headset.

32. A stationary exercise apparatus for simulating actual movement according to Claim 26, further comprising an audio feedback device.

33. A stationary exercise apparatus for simulating actual movement according to Claim 26, wherein at least one movement sensor is disposed on the tilting means to sense tilting action during operation.

34. A stationary exercise apparatus for simulating actual movement according to Claim 26, wherein at least one movement sensor is disposed so as to sense steering changes made to the exercise bicycle by the operator during operation.

35. A stationary exercise apparatus for simulating actual movement according to Claim 26, wherein at least one movement sensor is disposed so as to sense rolling changes made to the rear wheel of the bicycle by the operator during operation.

36. A stationary exercise apparatus for simulating actual movement according to Claim 26, wherein the operator uses the control switches to control the interactive electronic processor.

37. A stationary exercise systems for simulating actual movement experienced during free bicycle riding on an actual road surface, the system including:

an exercise bicycle mounted on a support frame, the bicycle having a seat upon which an operator can sit and a handlebar, the support frame including tilting means for allowing the bicycle to tilt about an axis longitudinal to the bicycle responsive to a shift in weight by the operator, the tilting means including

at least one rocker arm, each rocker arm being disposed so as to rock about the axis longitudinal to the bicycle,

at least one spring corresponding to each rocker arm for providing resistance when the weight shift occurs; and

audiovisual sensory means for providing input to the operator of the exercise bicycle.

38. A stationary exercise system for simulating actual movement according to Claim 34, further including impedance means for providing a resistive force as the operator operates the exercise bicycle.

39. A stationary exercise system for simulating actual movement according to Claim 35, wherein the impedance means comprises an electromagnetic resistor which responds to pedaling action by the operator.

40. A stationary exercise system for simulating actual movement according to Claim 36, wherein the electromagnetic resistor is selectively variable.

41. A stationary exercise system for simulating actual movement according to Claim 37, wherein the electromagnetic resistor is selectively variable responsive to electronic input provided by the audiovisual sensor means.

42. A stationary exercise system for simulating actual movement according to Claim 34, wherein the audiovisual sensory means comprises

a plurality of movements sensors disposed at strategic position on the exercise bicycle and support frame;

a plurality of control switches disposed on the exercise bicycle within easy reach of the operator;

an interactive electronic processor for receiving input and rendering output information responsive to information received from the sensors and switches; and

an interface controller for making compatible the input information received from the sensors and switches and the output information rendered by the processor.

43. A method of using a stationary exercise system for simulating actual movement experienced during free bicycle riding on an actual road surface, the method comprising the steps of:

a) connecting an exercise bicycle to a support frame, the support frame maintaining the bicycle in a relatively stationary position and including tilting means for allowing the bicycle to tilt about an axis longitudinal to the bicycle responsive to a shift

in weight by the operator, the tilting means including at least one rocker arm and at least one spring corresponding to each rocker arm; and

b) connecting the exercise bicycle to audiovisual sensory means for providing input to the operator of the exercise bicycle.

44. A method of using a stationary exercise system for simulating actual movement experienced during free bicycle riding on an actual road surface according to Claim 40, further comprising the step of operating the stationary exercise system by providing control switches to the operator whereby an interactive electronic processor is controlled.

45. A method of using a stationary exercise system for simulating actual movement experienced during free bicycle riding on an actual road surface according to Claim 41, wherein movement of the exercise bicycle, including tilting movement, is sensed by movement sensors disposed at strategic positions on the exercise bicycle and support frame.

46. A method of using a stationary exercise system for simulating actual movement experienced during free bicycle riding on an actual road surface according to Claim 42, wherein an interface controller makes compatible input information received from the sensors and switches and output information rendered by the interactive electronic processor.

47. A method of using a stationary exercise system for simulating actual movement experienced during free bicycle ridincg on an actual road surface according to Claim 40, further comprising the step of operating the stationary exercise system by operating the exercise bicycle by rotating axially opposed pedals, thereby providing exercise to the operator.

48. A method of using a stationary exercise system for simulating actual movement experienced during free bicycle riding on an actual road surface according to Claim 44, wherein impedance means provides a resistive force as the operator rotates the axially opposed pedals.

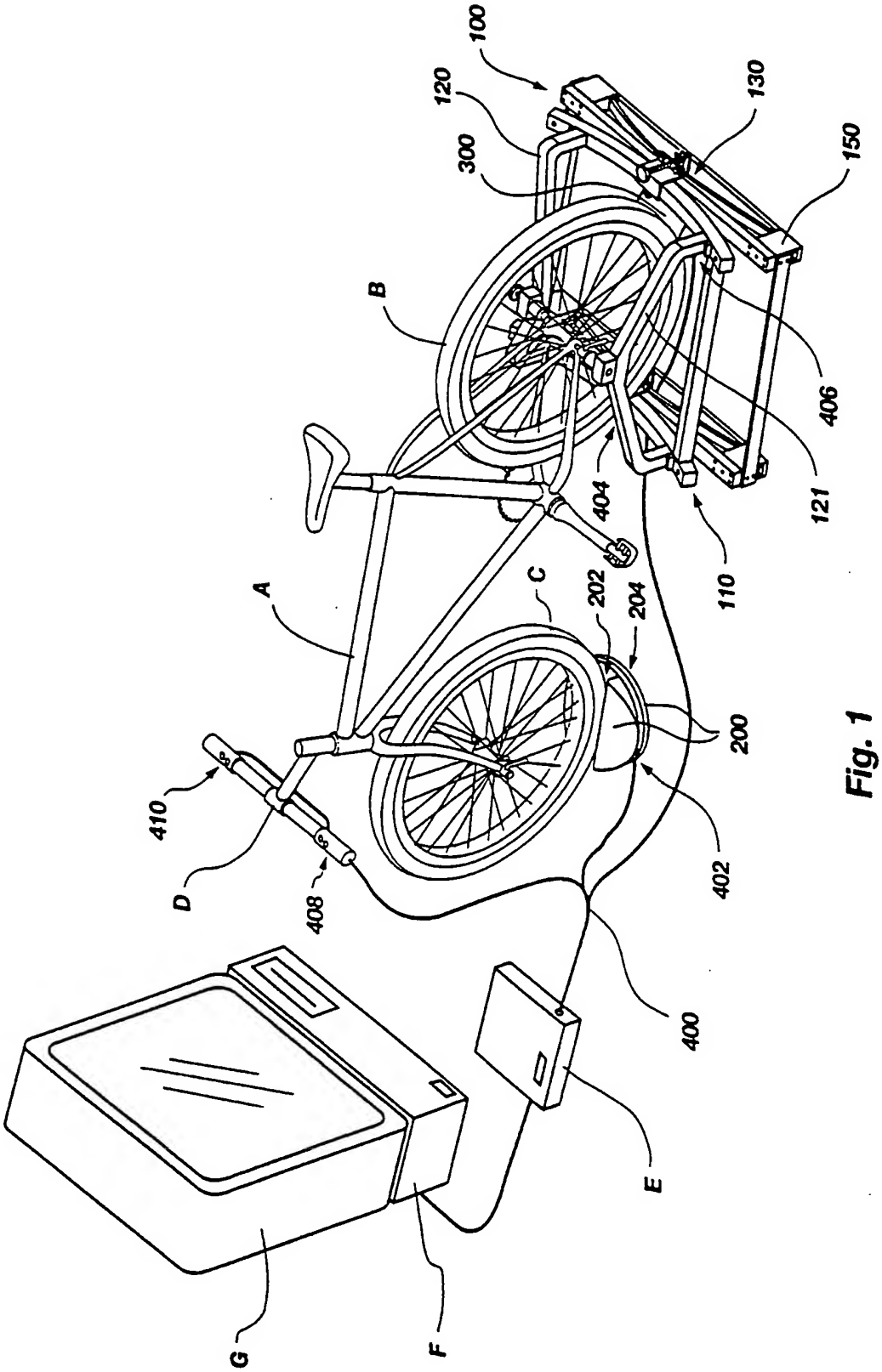
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Fig. 1

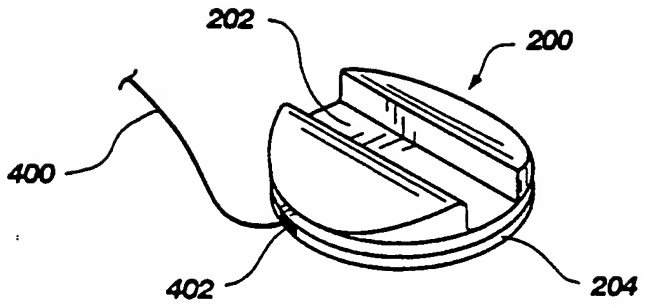
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Fig. 3

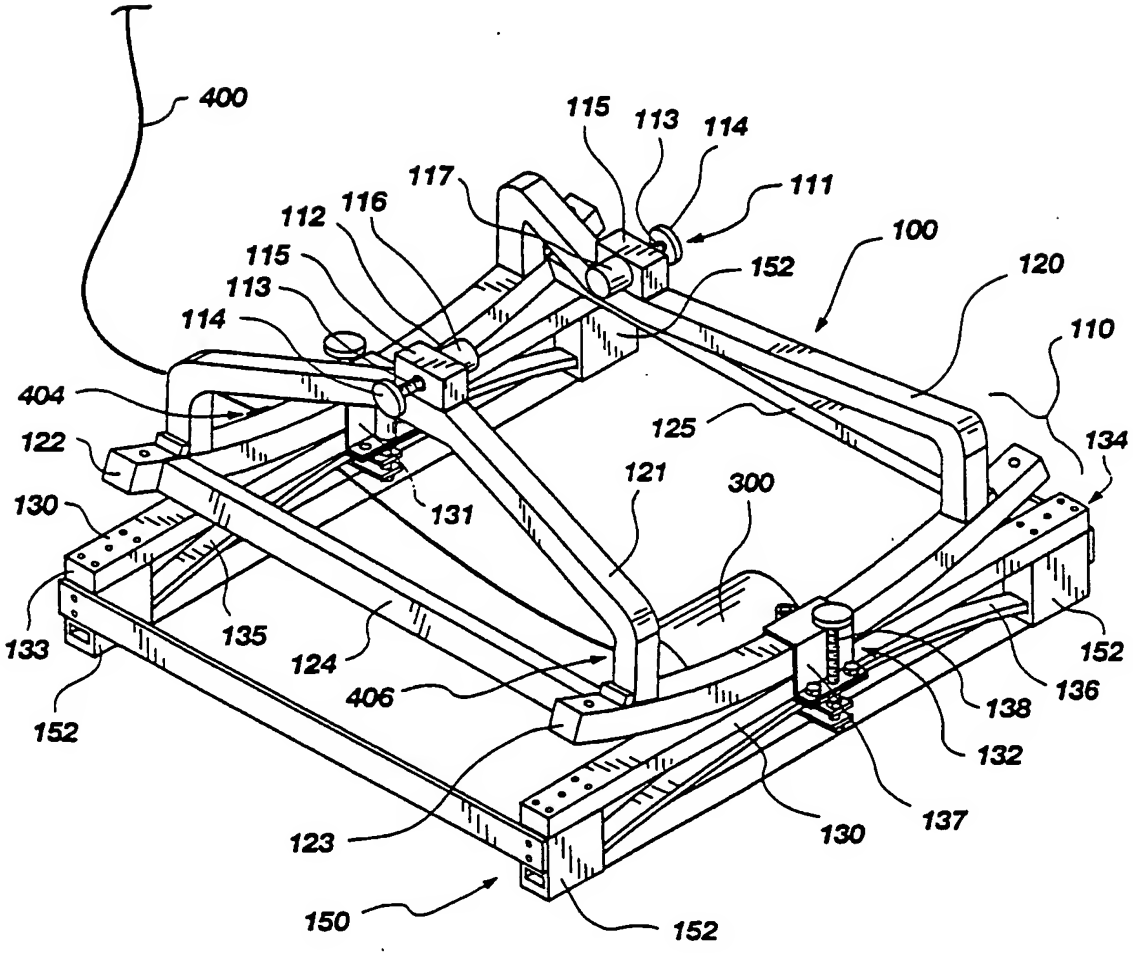
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Fig. 2

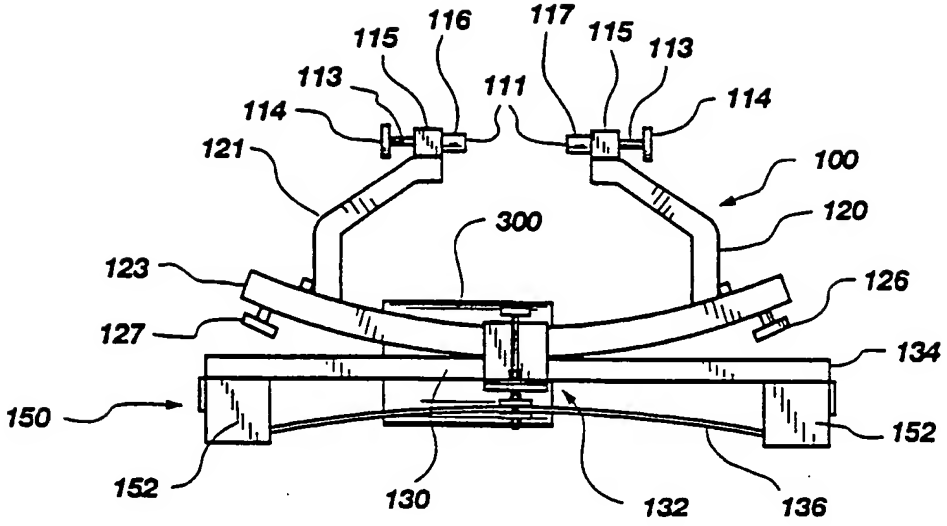
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Fig. 4

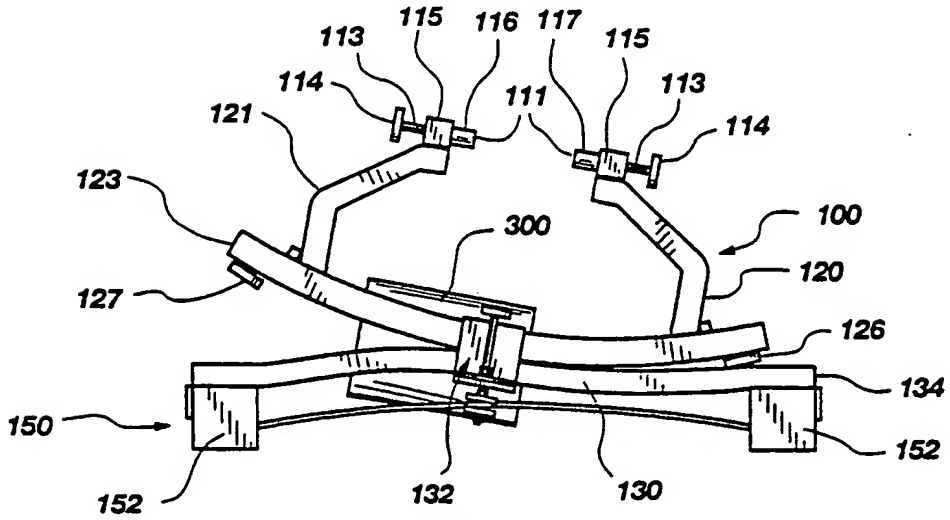
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Fig. 5

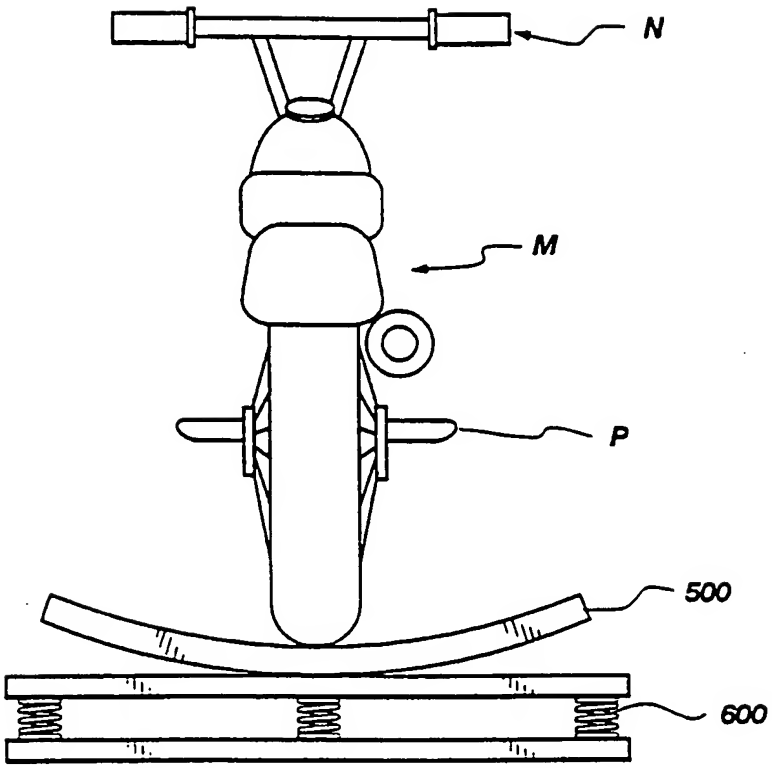

Fig. 6

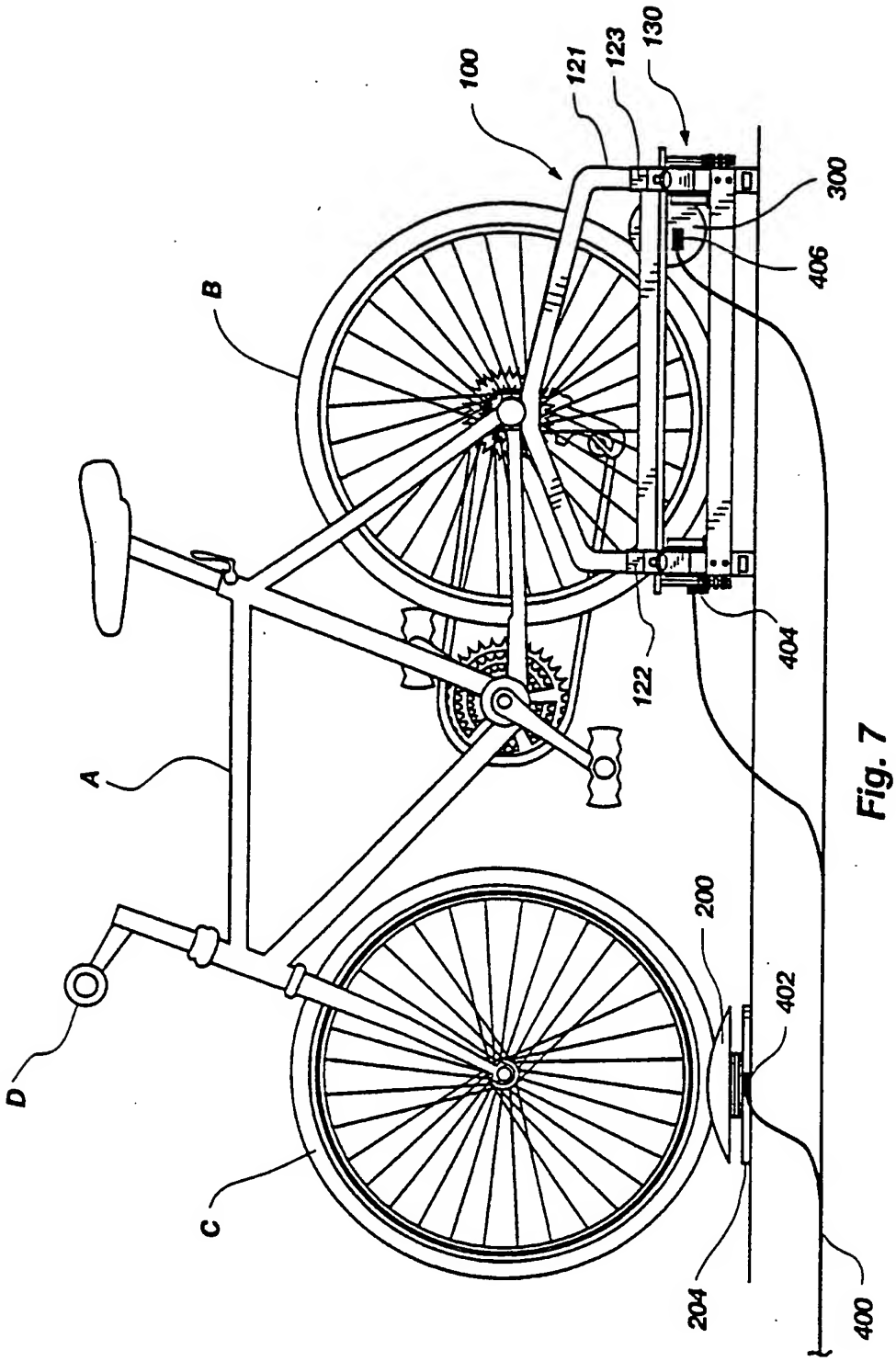

Fig. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/07323

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :A63B 11/06, 71/00
US CL :482/8, 57

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 434/61, 247; 482/1, 4-8, 57, 61, 900-903

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 4,817,939 (AUGSPURGER ET AL.) 04 APRIL 1989, see the entire document.	1-48
Y	US, A, 5,240,417 (SMITHSON ET AL.) 31 August 1993, see the entire document.	1-48
Y	US, A, 5,382,208 (HU) 17 January 1995, see the Fig. 2 permanent magnets (42).	25, 39-41
A	US, A, 5,006,072 (LETOVSKY ET AL.) 09 April 1991, see the entire document.	1-48
A	US, A, 4,976,435 (SHATFORD ET AL.) 11 December 1990, see the entire document.	1-48

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

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"O" document referring to an oral disclosure, use, exhibition or other means

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search
13 AUGUST 1996

Date of mailing of the international search report
02 OCT 1996

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